DESIGN MEMORANDUM

on

KENNEBUNK RIVER, MAINE

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

May 1964

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASS. 02154

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.
NEDED-R

28 May 1964

SUBJECT: Design Memorandum for Kennebunk River, Maine

TO: Chief of Engineers
ATTN: ENGCW-E
Washington, D. C.

1. Reference is made to letter of 29 October 1962, Subject: Work Allowances for FY 1963, and letter of 17 February 1964, Subject: Work Allowances for Small Authorized Projects, which provided funds in the amounts of $17,000 and $5,000 respectively, for preconstruction planning including preparation of design memorandum, on Kennebunk River, Maine.

2. Four copies of the subject design memorandum, prepared in accordance with EM 1110-2-1150 and EM 1110-2-2904, are inclosed. The work to be undertaken involves dredging operations with no special design or excavation problems, and extension of an existing jetty. The design of the jetty extension was developed in the survey report in accordance with existing design criteria. Some minor changes in design criteria have been made which are reflected in this design memorandum. The design memorandum is approved in accordance with paragraph 6 (b) of EM 1110-2-1150.

3. Planning on this project is about 85% complete. Formal assurances have been received from the towns of Kennebunk and Kennebunkport. The State of Maine has indicated it will forward the State assurance shortly. Bids are scheduled to be received 16 July 1964 and a request for allotment of construction funds will be made based on the bids received.

OTTO J. ROHDE
Colonel, Corps of Engineers
Acting Division Engineer

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PERTINENT DATA

1. A summary of physical features and costs of the existing project for Kennebunk River, Maine is as follows:

Features	Present Estimate(1964)
Completed Modifications	$ 84,000
Uncompleted Modifications:	
Dredge 8 and 10-foot channels and 6-foot anchorages; and extend existing jetty	360,000*
Total Project Cost	$ 444,000

*Includes $90,000 local cash contribution

PROJECT AUTHORIZATION

2. The uncompleted project modification for the improvement of Kennebunk River, Maine, authorized by the River and Harbor Act of 23 October 1962, provides for: A channel 8 feet deep and 100 feet wide extending 1700 feet from deep water to the Town Landing, thence 6 feet deep over a width of 100 feet for a distance of about 2,300 feet and a width of 75 feet for the remaining 2,000 feet to the project limit; an anchorage, 4 acres in area, on the west side of the channel and an anchorage, 2 acres in area, on the east side, each 6 feet deep; and extension of the west jetty by about 330 feet, supplemented by a sand fence.

3. The project modification was authorized subject to the requirements that prior to construction local interests agree to:

a. Contribute in cash 25 percent of the first cost of construction, to be paid in a lump sum prior to initiation of construction, subject to final adjustment after actual costs have been determined.

b. Provide without cost to the United States, all lands, easements, rights-of-way required for construction and subsequent maintenance of the improvements and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works.

c. Hold and save the United States free from damages due to the construction works and maintenance of the improvement; and

d. Improve and maintain the existing public landing, including access to the dredged channel open to all on equal terms. No work has been initiated on this uncompleted modification.

4. Prior to authorization of the uncompleted modification authorized by the River and Harbor Act of 1962, the existing project which was adopted in 1829 and supplemented by enactments to 1890, provided for the construction of a stone breakwater on the easterly side of the river's mouth, about 550 feet long; a pier or jetty on the westerly side about 290 feet long, each on a parcel of land owned by the United States, the construction of a wharf (transferred to the Treasury Department in 1936 and now owned by the town) about 700 feet upstream from the shore end of the east breakwater; the construction of another jetty on the east bank; and securing a depth of 4 feet, by dredging and rock removal for a width of 100 feet to Kennebunkport. The existing project was completed in 1893. The project depth of 4 feet was restored in 1950 and repairs to the damaged sections of the stone breakwater at the easterly side of the river's mouth were made in 1954, and to the west jetty in 1962. The total costs under the existing project have been $248,000 of which $84,000 was for new work and $164,000 for maintenance.

INVESTIGATIONS

5. Physical investigations carried out in support of the survey

report contained in House Document 459, 87th Congress, 2nd Session, are as follows:

a. Hydrographic surveys were made in August and September 1959 and probing and typographic surveys were made in June 1960.

6. Subsequent to project authorization, data in the survey report was supplemented by detailed field investigations consisting of hydrographic, topographic and probing surveys made in January and February 1963 and boring surveys in February and September 1963 to determine the character of materials to be dredged from the channel and anchorages. Probings to determine foundation conditions at the new jetty extension were made in April 1964.

7. The history of the two jetties at the mouth of the river dates back many years prior to 1829 when the Federal Government made its first appropriation for repair of the wooden piers built by local interests to protect the entrance to the river. Subsequent enactments provided funds to repair these structures and during the period 1829-52, granite piers were erected at the entrance. The west jetty, which is under consideration in the design memorandum, was completed in 1871 to its present dimensions of 160 feet for the wing wall and 290 feet for the main trunk. The west jetty was constructed of heavy granite stone carefully laid up in steps without mortar. In the years subsequent to 1871, periodic repairs were made to the structures by replacing the granite blocks dislodged by storms and ice. In 1935 about 500 tons of rubblestone was placed on the seaward side of the east jetty. Additional repairs to the east jetty were made in 1954 by replacing dislodged granite blocks. In 1962 a stone berm of riprap was placed along the west jetty in addition to stone dogs tieing the top course together.

8. The proposed extension of the west jetty is designed to reduce shoaling by intercepting and impounding the natural littoral transport from the adjacent Gooch Beach.

9. Design criteria is based on EM 1110-2-2904 and information formulated in the survey report. The slope and size of armor stone is based on the Waterway Experiment Station formula and graphs contained in above referenced manual. The resulting factors are tabulated in Appendix A.

LOCAL COOPERATION

10. The requirements of local cooperation are stated in paragraph 3 above. Since the Kennebunk River is the boundary line between the Towns of Kennebunk and Kennebunkport, requirements of local cooperation were sent to both towns. Formal assurances have been executed by the towns and receipt of assurances from the State of Maine is expected shortly. The project plan has been reviewed with the Governor of the State of Maine, Maine Port Authority, Boards of Selectmen of Kennebunk and Kennebunkport, and the local Waterfront Development Committee in various conferences during the construction planning phase. The names of some of the principal officers and representatives contacted during the preconstruction planning phase are listed below:

Governor John H. Reed, State House, Augusta, Maine
Mr. Elmont Tyndale, State Representative
Mr. Edward Langlois, Gen. Mgr., Maine Port Authority, Portland, Maine
Mr. Robert York, Town Manager, Kennebunk, Maine
Mr. M. Abbott Pendergast, Chairman, Board of Selectmen, Kennebunkport, Maine
Mr. A. B. Brook, Chairman, Harbor Development Comm., Kennebunk, Maine
Mr. Philip Saxe, Chairman, Planning Board, Kennebunk, Maine

LOCATION AND TRIBUTARY AREA

11. Kennebunk River is located in the southwestern part of Maine, emptying into the Atlantic Ocean about 30 miles southwest of Portland Harbor. At Kennebunkport, at the head of the existing project, about 1 mile above its mouth, the river is crossed by a swing highway bridge. Although tidewater extends to Kennebunk Landing about 3 miles above the mouth of the river, improvement of the river by the United States has been limited to approximately the lower mile. Entrance into the river from the open sea is made between two jetties at the river mouth.

12. The towns of Kennebunk and Kennebunkport situated on either side of the river mouth are the principal towns on the river. This locality is a well-known summer resort with many large hotels. The availability of beaches and recreational facilities attract large crowds and during the summer the population is expanded many times over the year round population of 4,551 at Kennebunk and 1,851 at Kennebunkport.

During the summer there are many yachts and pleasure craft on the river. The servicing of and providing for the needs of the summer tourists is the main source of income to the towns. Commercial fishing is the only year round industry. There are no bridges over that part of the river which comes within the limits of the existing Federal project.

PROJECT PLAN

13. The project plan is the same as recommended in House Document 459, 87th Congress, 2d Session, which provides for deepening the river channel to 8 feet, 100 feet wide extending 1700 feet from deep water to the Town Landing, thence 6 feet deep over a width of 100 feet for a distance of 2,300 feet and 75 feet wide for the remaining 2,000 feet to the project limit; an anchorage, 4 acres in area, on the west side of the channel and an anchorage, 2 acres on the east side, each 6 feet deep; and extension of the west jetty by about 330 feet, supplemented by construction of a sand fence. The project plan is shown on the attached map.

14. The channel and anchorage areas are proposed to be dredged by the hydraulic method with disposal of materials on areas along the river and on Gooch's Beach as provided by local interests. There is a small amount of ledge rock in the entrance channel, locally known as "Riding Rock", and some ledge rock near the 4 acre anchorage to be removed. Dredging quantities are in terms of in-place measurement and include an allowance of 1 foot overdepth. Side slopes of 1 on 3 are used in ordinary dredging and 1 on 1 in ledge rock.

15. The proposed extension of the west jetty was designed to reduce shoaling by intercepting and impounding littoral drift which would otherwise move towards and into the river from the sandy shores of Gooch Beach on the west. Stone construction for the jetty was selected as the type which would be most economical to build and to maintain. A top width of 6 feet was selected for the trunk as the minimum in which riprap of adequate size could be used. Side slopes on the jetty trunk will be 1 on 1.5. Design cap stone to be used on the trunk will be 2.0 tons. A top width of 8 feet was used for the jetty tip with side slopes on the tip to be 1 on 2. Cap stone to be used on the tip is 5 tons. The jetty extension will be made sand tight by a core of quarry run stone.

16. Overtopping is not a consideration. Therefore, provision of a flatter slope of 1 on 2, using heavier stone, at the end of the jetty with a transition to a steeper slope of 1 on 1.5 would be sufficient at the end of the jetty. Design computations are shown in Appendix A.

COST ESTIMATES

17. The current estimate of cost is based on quantities determined from detailed sounding, probing and boring surveys and include an allowance of one foot of overdepth in ordinary dredging and one foot in rock removal with one foot additional required depth below project depth in rock. Present estimate of project cost is based on hydraulic disposal on lands furnished by local interests, suitably diked, and prices prevailing in May 1964.

18. Current Estimate of Costs (May 1964)

Dredging 8' and 6' Channel and 6' anchorage		
140,000 c.y. @ $1.20/c.y.	$168,000	
Contingencies	26,000	
Rock removal 500 c.y. @ $40/c.y.	20,000	
Contingencies	1,000	
Jetty and sand fence		
10,800 tons @ $7.75/ton	84,000	— 69,990.50 Contract amt
400 LF fence @ $2.50/LF	1,000	—
Contingencies	12,000	
Engineering and Design	22,000	21,400 spent 9/30/64
Supervision and Administration	26,000	
Total	$360,000	

19. Comparison of Costs

	Document Estimate (Sept 1961)	Latest Approved Estimate (July 1962)	Current Estimate (May 1964)
Dredging including contingencies	$209,000	$209,000	$194,000
Rock removal including contingencies	6,000	6,000	21,000
Jetty and sand fence, including contingencies	97,000	97,000	97,000
Preauthorization Studies	10,000	deleted	deleted
Engineering & Design	17,000	17,000	22,000
Supervision and Administration	31,000	31,000	26,000
Totals	$370,000	$360,000	$360,000

20. Allocation of Costs

	Document Estimate (Sept 1961)	Latest Approved Estimate (July 1962)	Current Estimate (May 1964)
Federal			
Dredging including contingencies	-	$156,750	$145,500
Rock removal including contingencies	-	4,500	15,750
Jetty and sand fence, including contingencies	-	72,750	72,750
Preauthorization Studies	-	deleted	deleted
Engineering & Design	-	13,000	16,500
Supervision & Administration	-	23,000	19,500
Total Fed. (Corps of Engineers Costs)	$280,000*	$270,000	$270,000
Aids to Navigation	2,000	2,000	2,000
Total Federal	$282,000	$272,000	$272,000

*Not broken down in authorizing document

	Document Estimate (Sept 1961)	Latest Approved Estimate (July 1962)	Current Estimate (May 1964)
Non-Federal			
Dredging including contingencies	-	$52,250	$48,500
Rock removal including contingencies	-	1,500	5,250
Jetty and sand fence, including contingencies	-	24,250	24,250
Preauthorization Studies	-	0	0
Engineering & Design	-	4,000	5,500
Supervision & Administration	-	8,000	6,500
Total Non-Fed. Costs	$90,000*	$90,000	$90,000

*Not broken down in authorizing document

SCHEDULES FOR DESIGN AND CONSTRUCTION

21. The improvement of Kennebunk River as proposed in House Document 459, 87th Congress, 2d Session will be undertaken under two contracts. The dimensions of the channel and anchorages as developed in the referenced document are considered adequate to meet the needs of navigation. The design of the jetty extension has been refined to reflect new design criteria in EM 1110-2-2904, 30 April 1963. The following schedule incorporates desires of local interests to perform no construction work during the summer resort season.

a. Jetty Extension:

Issue plans & specifications	June 26, 1964
Open bids	July 16, 1964
Award	July 23, 1964
Start construction	Sept. 8, 1964
Complete construction	Nov. 15, 1964

b. Channel and Anchorage:

Issue plans & specifications	June 26, 1964
Open bids	July 16, 1964
Award	July 23, 1964
Start construction	Sept. 8, 1964
Complete construction	Jan. 16, 1965

Fund Requirements:

Allotted to date	$ 22,000
Additional funds required to complete	$253,000

OPERATION AND MAINTENANCE

22. Maintenance of the authorized improvement is the responsibility of the United States. Annual maintenance of the channel and anchorage consists of periodic dredging to restore project depths. The estimate for additional maintenance of the channel and anchorage area, with the jetty extension, is based on an average shoaling rate of one foot in 15 years, an annual rate of 2,000 cubic yards, estimated to cost $4,000. It has been estimated that replacement of 150 tons of stone would be required every 10 years for maintenance of the jetty, or an annual rate of 15 tons estimated to cost $150.

BENEFITS

23. As a result of improving the river tangible benefits are expected to accrue to both fishing and pleasure boats from the reduction or elimination of tidal delays, the increased use of the existing fleet now based in the harbor, the addition of new boats to the local fleet, as well as the increased number of transient boats, and a reduction of boat damage. A summary of benefits follows:

Fishing Fleet

Increased lobster catch	$17,600
Increased groundfish catch	1,200
Increased herring catch	10,000
Tidal delay cost to carriers	1,030
Reduced damage	1,300

Recreational Boating

Existing fleet	7,520
New Boats (Immediate)	6,390
New Boats (Gradual growth)	11,760
Transient (Present & Prospective)	1,560
Reduced damage	2,500
Total Benefits	$60,860

24. Annual charges computed in the authorizing document were based on an interest rate of 2 5/8 percent for the Federal investment and 3 1/2 percent for the non-Federal investment over a project life of 100 years. Current annual charges are computed at an interest rate of 3 percent for both Federal and non-Federal investment, and the project life is estimated at 50 years.

Annual Charges	Federal	Non-Federal	Total
Investment	$272,000	$90,000	$362,000
Project life	50 years	50 years	50 years
Interest rate	3%	3%	
Interest and Amortization	.038866	.038866	$ 14,000
Maintenance	$ 4,300*	0	$ 4,300*
Total	$ 14,800	$ 3,500	$ 18,300

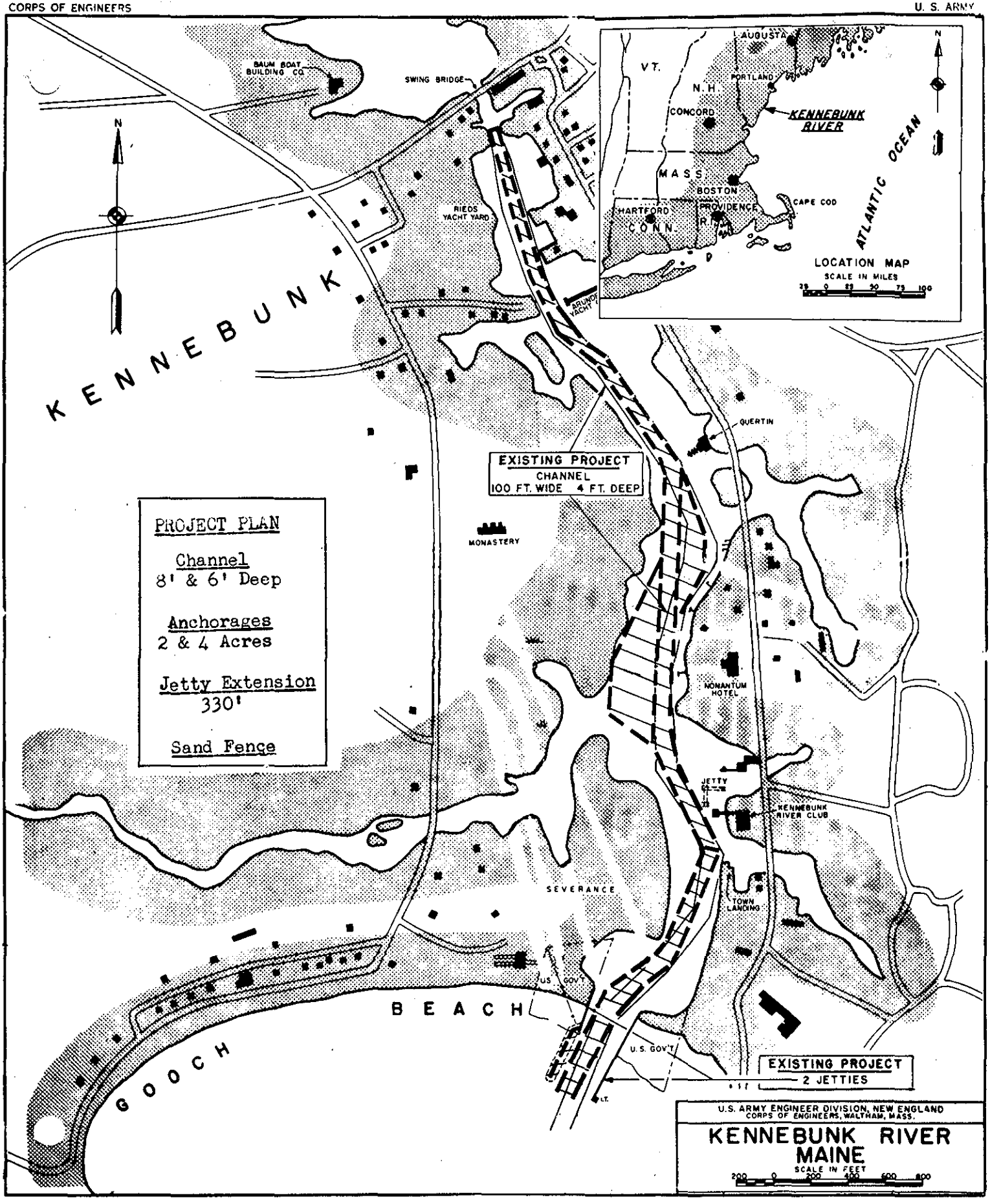
*Includes $150 for navigation aids

25. A comparison of estimated annual benefits of $60,860 to estimated annual charges of $18,300 yields a benefit-cost ratio of 3.3 to 1.

RECOMMENDATIONS

26. The plan proposed in this design memorandum provides for a channel 100 feet wide with a depth of 8 feet for the first 1700 feet, a depth of 6 feet for the next 2,300 feet, and 75 feet wide and a depth of 6 feet for the final 2,000 feet; for 2 anchorages, one of 4 acres, the other of 2 acres both 6 feet deep; and for the extension of the west jetty a distance of about 330 feet and the construction of a sand fence. This project plan will adequately serve the needs of the present and prospective navigation activity on the river and is adequately justified. It is recommended that the project be constructed as described.

Incl: Map
Appendix A


KENNEBUNK
BAUM BOAT BUILDING CO.
SWING BRIDGE
RIEDS YACHT YARD
APUNDY YACHT
QUERTIN
EXISTING PROJECT
CHANNEL
100 FT. WIDE 4 FT. DEEP
MONASTERY
NONANTUM HOTEL
JETTY
KENNEBUNK RIVER CLUB
SEVERANCE
TOWN LANDING
U.S. GOV'T
BEACH
GOOCH
EXISTING PROJECT
2 JETTIES
PROJECT PLAN
Channel
8' & 6' Deep
Anchorages
2 & 4 Acres
Jetty Extension
330'
Sand Fence
AUGUSTA
VT.
N.H.
PORTLAND
CONCORD
KENNEBUNK RIVER
ATLANTIC OCEAN
MASS.
BOSTON
CAPE COD
HARTFORD
PROVIDENCE
CONN.
R.I.
LOCATION MAP
SCALE IN MILES
25 0 25 50 75 100
N
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.
KENNEBUNK RIVER
MAINE
SCALE IN FEET
200 0 200 400 600 800

APPENDIX A

Jetty Head

Tide - 12 Feet (extreme storm tide)

Water Depth - 1.5 Feet

Still Water Level - 13.5 Feet

Design Wave - 10.5 Feet (SWL ./. 1.3)

$$W_r = \frac{\gamma_r H^3}{K_\Delta (S_r - 1)^3 \cot \alpha}$$

$\gamma_r = 163\#/ft.^3$

$H = 10.5'$

$S_r = 2.58$

$K_\Delta = 2.5$

$\cot \alpha = 2$ $\quad \therefore w_r = 9578\#$ say 5 Ton Stone

Jetty Trunk

$$W_r = \frac{\gamma_r H^3}{K_\Delta (S_r - 1)^3 \cot \alpha}$$

$H = 7.5$

$K_\Delta = 3.0$

$\cot \alpha = 1.5$ $\quad \therefore w_r = 3878\#$ say 2 Ton Stone

Crest Width (Trunk)

$$B = K_{\Delta} \left(\frac{Wr}{\gamma_r} \right) 1/3$$

$K_{\Delta} = 1.0$

$W_r = 40000^{\#}$

$\gamma_r = 163^{\#}$

$B = 5.6'$ say $\underline{6'}$

Crest Width (Head)

$$B = 2 K_{\Delta} \left(\frac{Wr}{\gamma_r} \right) 1/3$$

$K_{\Delta} = 1.0$

$W_r = 10,000^{\#}$

$\gamma r = 163^{\#}$

$\therefore B = 7.9'$ say $\underline{8'}$